2-3.6 Emergency Relief Venting for Fire Exposure for Aboveground Tanks.

2-3.6.1 Except as provided in 2-3.6.2, every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. This requirement shall also apply to each compartment of a compartmented tank, the interstitial space (annulus) of a secondary containment-type tank, and the enclosed space of tanks of closed-top dike construction. Spaces or enclosed volumes, such as those intended for insulation, membranes, or weather shields, that can contain liquid because of a leak from the primary vessel and can inhibit venting during fire exposure shall also comply with this subsection. The insulation, membrane, or weather shield shall not interfere with emergency venting.

2-3.6.2 Tanks larger than 285 bbl (45,306 L) capacity storing Class IIIB liquids and not within the diked area or the drainage path of Class I or Class II liquids shall not require emergency relief venting.

2-3.6.3 In a vertical tank, the construction referred to in 2-3.6.1 shall be permitted to take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure-relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam. Design methods that will provide a weak roof-to-shell seam construction are contained in API 650, Welded Steel Tanks for Oil Storage, and UL 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids.

2-3.6.4 Where entire dependence for emergency relief is placed upon pressure-relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 2-8 except as provided in 2-3.6.6 or 2-3.6.7. Such devices shall be vaportight and shall be permitted to be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank, and the first 30 ft (9 m) above grade of the exposed shell area of a vertical tank. (See Appendix B for the square footage of typical tank sizes.)

Table 2-8 Wetted Area versus ft^3 Free Air per Hour1 [14.7 psia and 60ºF (101.3 kPa and 15.6ºC)]

ft^2	CFH	ft^2	CFH	ft^2	CFH
20	21,100	200	211,000	1000	524,000
30	31,600	250	239,000	1200	557,000
40	42,100	300	265,000	1400	587,000
50	52,700	350	288,000	1600	614,000
60	63,200	400	312,000	1800	639,000
70	73,700	500	354,000	2000	662,000
80	84,200	600	392,000	2400	704,000
90	94,800	700	428,000	2800	742,000
100	105,000	800	462,000	and over	
120	126,000	900	493,000		
140	147,000	1000	524,000		
160	168,000				

180	190,000
200	211,000

SI units: 10 ft^2 = 0.93 m^2; 36 ft^3 = 1.0 m^3.
1Interpolate for intermediate values.

2-3.6.5 For tanks and storage vessels designed for pressures over 1 psig (6.9 kPa), the total rate of venting shall be determined in accordance with Table 2-8, except that when the exposed wetted area of the surface is greater than 2800 ft2 (260 m2), the total rate of venting shall be in accordance with Table 2-9 or calculated by the following formula:

$CFH = 1107\ A^{0.82}$
Where:
CFH = venting requirement, in cubic feet of free air per hour
A = exposed wetted surface, in square feet
The foregoing formula is based on Q = 21,000 A0.82

Table 2-9 Wetted Area Over 2800 ft2 (260 m2) and Pressures Over 1 psig (gauge pressure of 6.9 kPa)

ft2	CFH	ft2	CFH
2800	742,000	9000	1,930,000
3000	786,000	10,000	2,110,000
3500	892,000	15,000	2,940,000
4000	995,000	20,000	3,720,000
4500	1,100,000	25,000	4,470,000
5000	1,250,000	30,000	5,190,000
6000	1,390,000	35,000	5,900,000
7000	1,570,000	40,000	6,570,000
8000	1,760,000		

SI units: 10 ft^2 = 0.93 m^2; 36 ft^3 = 1.0 m^3.

2-3.6.6 The total emergency relief venting capacity for any specific stable liquid can be determined by the following formula:

$$\text{Cubic feet of free air per hour} = \frac{V1337}{L(M)^{0.5}}$$

Where: V = cubic feet of free air per hour from Table 2-8
L = latent heat of vaporization of specific liquid in Btu per pound
M = molecular weight of specific liquids

2-3.6.7 For tanks containing stable liquids, the required airflow rate of 2-3.6.4 or 2-3.6.6 shall be permitted to be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one of the following factors shall be used for any one tank:
0.5 for drainage in accordance with 2-3.4.2 for tanks over 200 ft2 (18.6 m2) of wetted area;
0.3 for water spray in accordance with NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection, and drainage in accordance with 2-3.4.2;
0.3 for insulation in accordance with 2-3.6.7(a);
0.15 for water spray with insulation in accordance with 2-3.6.7(a) and drainage in accordance with 2-3.4.2 (see Appendix B).

Exception No. 1:* Where water-miscible liquids whose heats of combustion and rates of burning are equal to or less than those of ethyl alcohol (ethanol) are stored, processed, or handled and where there is no potential fire exposure from liquids other than these liquids, the above factors shall be permitted to be reduced by 50 percent. Drainage shall not be required to obtain this reduction. In no case shall the above factors be reduced to less than 0.15.
Exception No. 2: Where liquids that are not water-miscible and whose heats of combustion and rates of burning are equal to or less than those of ethyl alcohol (ethanol) are stored, processed, or handled and where there is no potential fire exposure from liquids other than these liquids, the above factors for insulation alone and drainage alone shall be permitted to be reduced by 50 percent. No further reduction shall be allowed for protection by means of water spray. Drainage shall not be required to obtain this reduction. In no case shall the above factors be reduced to less than 0.15.
(a) Insulation systems for which credit is taken shall meet the following performance criteria:
1. Remain in place under fire exposure conditions.
2. Withstand dislodgment when subjected to hose stream impingement during fire exposure. This requirement can be waived where use of solid hose streams is not contemplated or would not be practical.
3. Maintain a maximum conductance value of 4.0 Btu per hr per ft2 per degree Fahrenheit (Btu/hr/ft2/ºF) when the outer insulation jacket or cover is at a temperature of 1660ºF (904.4ºC) and when the mean temperature of the insulation is 1000ºF (537.8ºC).

2-3.6.8 The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 psig (17.2 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

2-3.6.9 Each commercial tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure. If the start to open pressure is less than 2.5 psig (17.2 kPa) and the pressure at full open position is greater than 2.5 psig (17.2 kPa), the flow capacity at 2.5 psig (17.2 kPa) shall also be stamped on the venting device. The flow capacity shall be expressed in cubic feet per hour of air at 60ºF (15.6ºC) and 14.7 psia (760 mm Hg).
(a) The flow capacity of tank venting devices under 8 in. (20 cm) in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests can be conducted by the manufacturer if certified by a qualified, impartial observer or can be conducted by a qualified, impartial outside agency. The flow capacity of tank venting devices 8 in. (20 cm) nominal pipe size and larger, including manhole covers with long bolts or equivalent, can be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the word “calculated” appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.
(b) A suitable formula for this calculation is:

$$CFH = 1667 C_f A (P_t - P_a)^{0.5}$$

Where:
CFH = venting requirement in cubic feet of free air per hour
C_f = 0.5 (the flow coefficient)
A = the orifice area in in.2
P_t = the absolute pressure inside the tank in inches of water
P_a = the absolute atmospheric pressure outside the tank in inches of water

2-3.7 Vent Piping for Aboveground Tanks.

2-3.7.1 Vent piping shall be constructed in accordance with Chapter 3.

2-3.7.2 Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 ft (3.6 m) above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least 5 ft (1.5 m) from building openings.

2-3.7.3 The manifolding of tank vent piping shall be avoided except where required for special purposes such as vapor recovery, vapor conservation, or air pollution control. Where tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they are required to handle when manifolded tanks are subject to the same fire exposure.

2-3.7.4 Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II or Class III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II or Class III liquids, to prevent contamination (see A-1-2) and possible change in classification of the less volatile liquid.

2-3.8 Tank Openings Other than Vents for Aboveground Tanks.

2-3.8.1 Each connection to an aboveground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-3.8.2 Each connection below the liquid level through which liquid does not normally flow shall be provided with a liquidtight closure. This can be a valve, plug, or blind, or a combination of these.

2-3.8.3 Openings for gaging on tanks storing Class I liquids shall be provided with a vaportight cap or cover. Such covers shall be closed when not gaging.

2-3.8.4 Fill pipes that enter the top of a tank shall terminate within 6 in. (15 cm) of the bottom of the tank. Fill pipes shall be installed or arranged so that vibration is minimized.
Exception: Fill pipes in tanks handling liquids that have a minimum potential for the accumulation of static electricity or fill pipes in tanks whose vapor space, under normal operating conditions, is not in the flammable range or is inerted need not meet this requirement. (Examples include most crude oils, residual oils, asphalts, and water-miscible liquids.)

2-3.8.5 Filling and emptying connections for Class I, Class II, and Class IIIA liquids that are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections for any liquid shall be closed and liquidtight when not in use and shall be properly identified.

IFC/2000 Section 3404.2.7.4. *Emergency vents for Class I, II, and IIIA liquids shall not discharge inside buildings.*